

MILITARY SPECIFICATION

RESISTOR, ADJUSTABLE, WIREWOUND, POWER

INACTIVE FOR DESIGN AFTER 24 NOVEMBER 1970.
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This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers power, adjustable, wirewound, resistors for use in electrical, electronic, communication, and associated equipment. These resistors have a resistance range of 1 ohm to 15,000 ohms, inclusive, and a resistance tolerance of ± 5 percent. The power ratings cover a range of 11 watts to 210 watts, inclusive. These power ratings are applicable only when the maximum resistance is engaged in the circuit. When only a portion of the resistance element is engaged, the power rating is reduced in approximately the same proportion as the resistance.

1.2 Classification.

1.2.1 Part or Identifying Number (PIN). The PIN is as follows:

<u>RX29</u>	<u>V</u>	<u>100</u>
Style	Characteristic	Resistance
(1.2.1.1)	(1.2.1.2)	(1.2.1.3)

1.2.1.1 Style. The style is identified by the two letter symbol RX followed by a two digit number, the letters identify power, wire wound, adjustable resistors, and the number identifies the size of the resistor.

1.2.1.2 Characteristic. The characteristic is identified by a single letter which identifies the maximum continuous operating temperature and the high ambient temperature derating of resistors, in accordance with table I.

TABLE I. Characteristic.

Symbol	Maximum continuous operating temperature ^{1/}	Derating curve
V	350°C	See figure 1

^{1/} This temperature is also the maximum permissible hotspot surface temperature.

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, ATTN: VAT, Post Office Box 3990, Columbus, Ohio 43218-3990 or by email Resistor@dla.mil . Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil/ .

MIL-R-19365E
w/Amendment 1

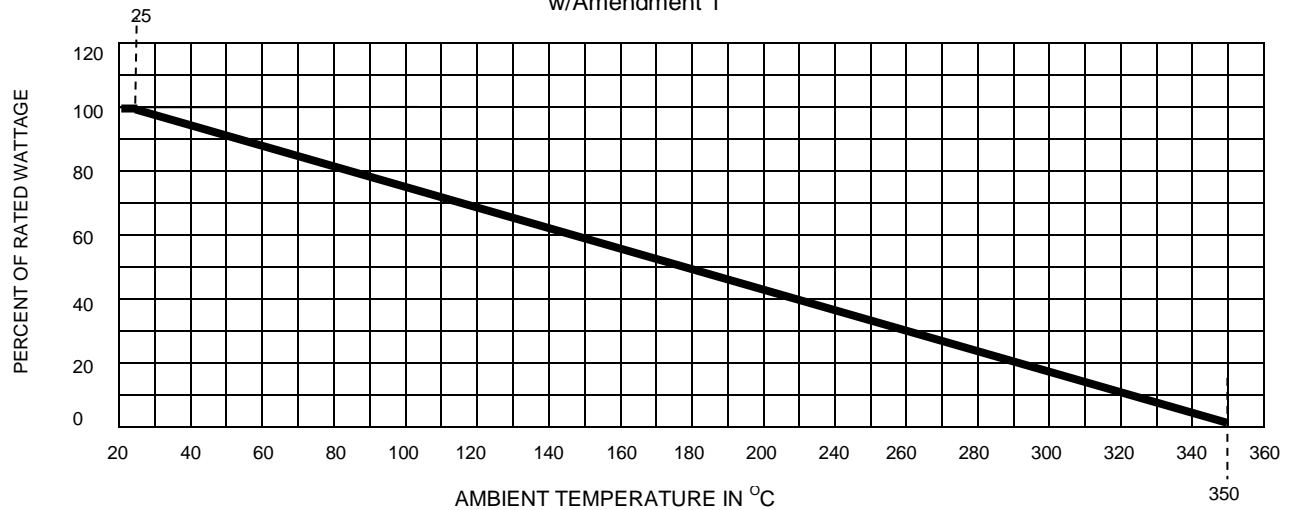


FIGURE 1. Derating curve for ambient temperatures.

1.2.1.3 Resistance. The nominal resistance value expressed in ohms is identified by a three digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow. Where fractional values of an ohm, and values of less than 10 ohms, are required, the letter R is substituted for one of the significant digits to represent the decimal point. When the letter R is used, the last digit becomes significant. The following are examples of symbols for resistance values:

1R0	=	1 ohm
100	=	10 ohms
101	=	100 ohms
102	=	1,000 ohms
103	=	10,000 ohms

1.2.1.3.1 Decade of resistance values. Resistance values in all decades for all styles will correspond to the values specified in the 10 to 100 decade in accordance with table II.

TABLE II. Resistance values.

Decade 10 to 100 of resistance values.			
10	18	33	56
11	20	36	62
12	22	39	68
13	24	43	75
15	27	47	82
16	30	51	91

MIL-R-19365E
w/Amendment 1

1.2.1.3.2 Resistance values. The minimum and maximum nominal total resistance values are accordance with table III.

TABLE III. Minimum and maximum resistance values.

Style	Resistance range in ohms	
	Minimum	Maximum
RX29	1	470
RX32		910
RX33		1,500
RX35		3,600
RX36		5,100
RX37		8,200
RX38		11,000
RX47		15,000

1.2.2 Power ratings. The nominal power ratings for the various styles are in accordance with table IV.

TABLE IV. Nominal power ratings. 1/

Characteristic V			
Style	Power ratings (watts)	Style	Power ratings (watts)
RX29	11	RX36	78
RX32	17	RX37	113
RX33	26	RX38	159
RX35	55	RX47	210

1/ Free space is predicated on horizontal mounting of the resistors with no object closer than 12 inches to the resistor, except the mounting base which is not closer than 2 inches below the resistors. Still air is air with no circulation other than created by the heat of the resistor being operated.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

FEDERAL STANDARDS

FED-STD-H28

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Screw Thread Standards for Federal Services.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202	-	Test Methods Standard Electronics and Electrical Components Parts.
MIL-STD-1285	-	Marking of Electrical and Electronic Parts.

(Copies of these documents are available online at <http://quicksearch.dla.mil>).

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents cited in the solicitation or contract (see 6.2).

INTERNATIONAL ORGANIZATION for STANDARDS (ISO)

ISO 10012	-	Measurement Management Systems - Requirements for Measurement Processes and Measuring Equipment
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(Copies of this document are available online at <http://www.iso.org/> or should be addressed to the American National Standards Institute, 11 West 42nd Street New York, NY 10036.)

NATIONAL CONFERENCE OF STANDARDS LABORATORIES

NCSL Z540.3	-	Calibration of Measuring and Test Equipment, Requirements for
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(Copies of this document are available from <http://www.ncsli.org/> or from the National Conference of Standards Laboratories (NCSL) International, 1800 30th Street, Suite 305, Boulder, CO 80301-1026.).

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence unless otherwise noted. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Requirements for individual resistor types. Requirements or exceptions applicable to individual types of resistors shall be as specified on figures 2 to 9, inclusive (see 6.2).

3.2 Qualification. Resistors furnished under this specification shall be products that are authorized by the qualifying activity for listing on the [Qualified Products List \(QPL\)](#) before contract award (see 4.4 and 6.3).

3.3 Materials. Materials shall be used which will enable the resistors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4 Interface and physical dimension requirements. Resistors shall meet the interface and physical dimensions specified herein. Resistors shall consist of tubes wound with a single layer of resistance wire and protected by a coating or an enclosure of insulating, moisture resistant material. The design of the resistors shall be such as to preclude shorting of turns and to obtain a minimum voltage drop between adjacent turns.

3.4.1 Protective coating or enclosure. The resistance element of resistors shall be protected by a coating or an enclosure which shall completely cover the exterior of the resistance element, except for a uniform exposed portion, 90° nominal from the fixed terminals, along one side of the body. The protective coating shall be free from holes, fissures, chips, and other faults.

3.4.2 Windings.

3.4.2.1 Wire. The wire shall have no joints, welds, or bonds, except at end terminals. The conductor and insulation (if employed) shall be free as practicable from particles of impurities, grain growth, or other factors contributing to spot weakness. The term wire will be throughout this specification to describe the resistance element.

3.4.2.2 Pitch. For round wire, the average winding pitch shall not exceed 300 percent of the wire diameter.

3.4.2.3 Effective wire coverage. Effective wire coverage is the winding length on the tube between points of departure from the normal winding pitch.

3.4.3 Terminals. Terminals shall be treated to facilitate soldering. They shall be firmly secured to the tube and shall not be solely dependent on the protective coating for mechanical anchorage. All terminals shall be so designed as to permit the secure crimping or hooking wire without depending upon soldering for mechanical strength. They shall support the wire without deformity. All terminals shall be radically straight and within 10 degrees of a plane passing through one of the terminals and the longitudinal axis of the resistor.

3.4.3.1 Adjustable terminals. Adjustable terminals shall make positive continuous contact with the turns of the winding, and shall be designed for fastening securely in the desired position.

3.5 Threaded parts. Where applicable, all threaded parts shall be in accordance with [FED-STD-H28](#).

3.6 Voltage rating. Resistors shall have a rated direct current (dc) continuous working voltage, or an approximate sine wave root mean square (rms) continuous working voltage at commercial line frequency and waveform corresponding to the power rating, as determined from the following formula:

$$E = \sqrt{PR}$$

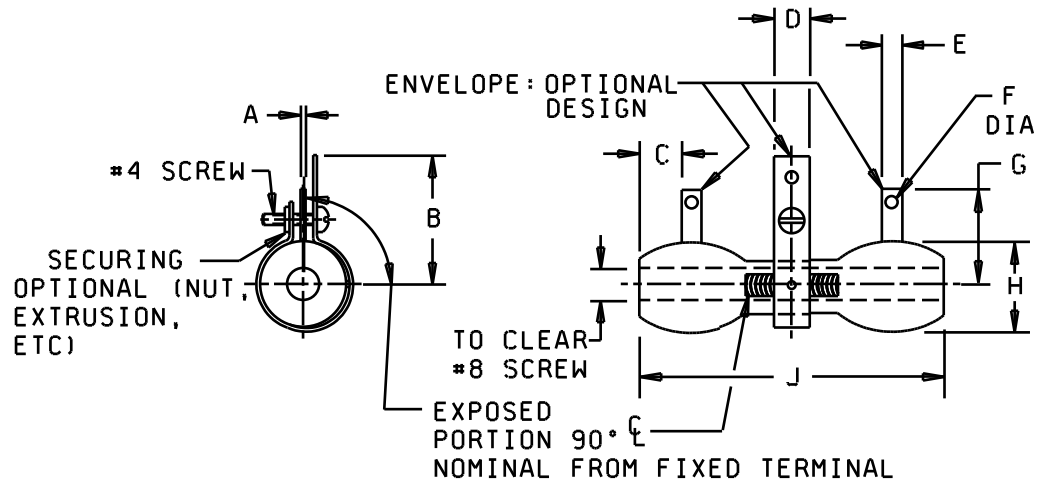
Where: E = rated dc or rms continuous working voltage.
P = power rating (see [3.1](#)).
R = nominal resistance.

3.7 DC resistance.

3.7.1 Total. When resistors are measured as specified in [4.7.1.1](#), the total dc resistance shall be within 5 percent of the nominal resistance value (see [1.2.1.3.1](#) and [3.1](#)).

3.7.2 Maximum engageability. When resistors are measured as specified in [4.7.1.2](#), the dc resistance shall be within 20 percent of the value recorded in 3.7.1 for resistors of 2-inch nominal lengths or less, and within 10 percent of the value recorded in 3.7.1 for resistors over 2 inch nominal lengths.

3.7.3 Resistance value deviations. All maximum deviations as specified in this section are to be considered absolute units with the exception of contact resistance adjustments.



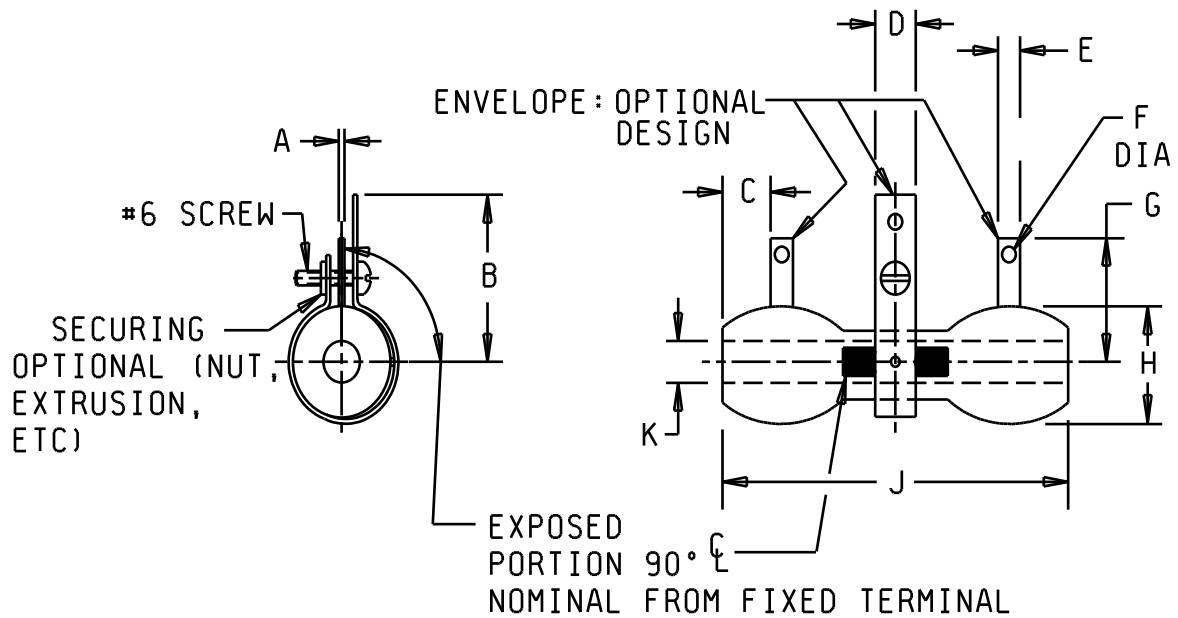
Letter	Inches (mm)		Letter	Inches (mm)	
	Min	Max		Min	Max
A	.016 (0.41)		F	.085 (2.16)	
B		.875 (22.23)	G	.500 (12.70)	.750 (19.05)
C	.062 (1.57)		H		.500 (12.70)
D	.171 (4.34)	.281 (7.14)	J	1.688 (42.88)	1.812 (46.02)
E	.171 (4.34)	.328 (8.33)			

Characteristic	Power rating (watts)	Resistance range in ohms	
		Minimum	Maximum
V	11	1	470

NOTES:

1. All dimensions in inches.
2. For information on supplementary insulation and standard bracket assembly (mounting hardware, see 6.6 and 6.7.1).

FIGURE 2. Style RX29.



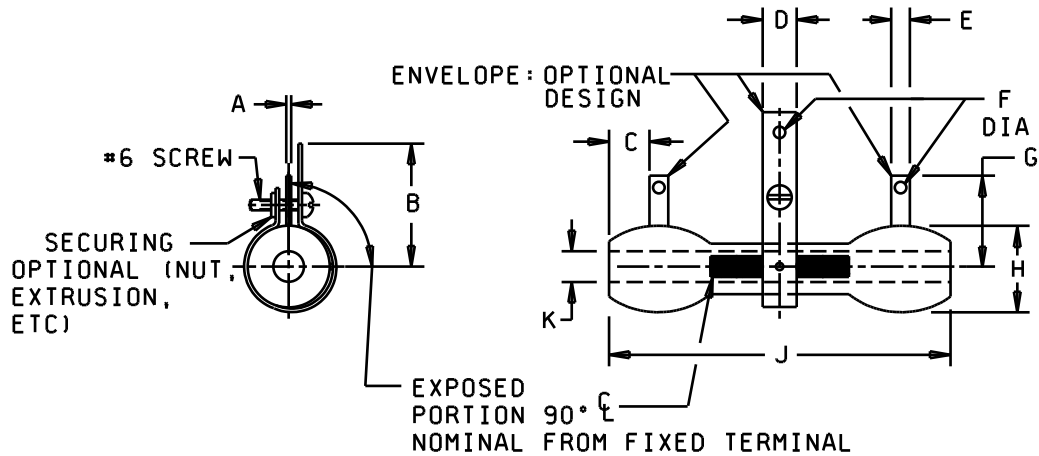
Letter	Inches (mm)		Letter	Inches (mm)	
	Min	Max		Min	Max
A	.016 (0.41)		F	.085 (2.16)	
B		1.171 (29.74)	G	.500 (12.70)	.750 (19.05)
C	.062 (1.57)		H		.593 (15.06)
D	.171 (4.34)	.281 (7.14)	J	1.938 (49.23)	2.062 (52.07)
E	.171 (4.34)	.328 (8.33)	K	.297 (7.54)	.437 (11.10)

Characteristic	Power rating (watts)	Resistance range in ohms	
		Minimum	Maximum
V	17	1	910

NOTES:

1. All dimensions in inches.
2. For information on supplementary insulation and standard bracket assembly (mounting hardware, see 6.6 and 6.7.1).

FIGURE 3. Style RX32.



Letter	Inches (mm)		Letter	Inches (mm)	
	Min	Max		Min	Max
A	.016 (0.41)		F	.085 (2.16)	
B		1.171 (29.74)	G	.500 (12.70)	.750 (19.05)
C	.062 (1.57)		H		.593 (15.06)
D	.171 (4.34)	.281 (7.14)	J	2.938 (74.63)	3.062 (77.77)
E	.171 (4.34)	.328 (8.33)	K	.297 (7.54)	.437 (11.10)

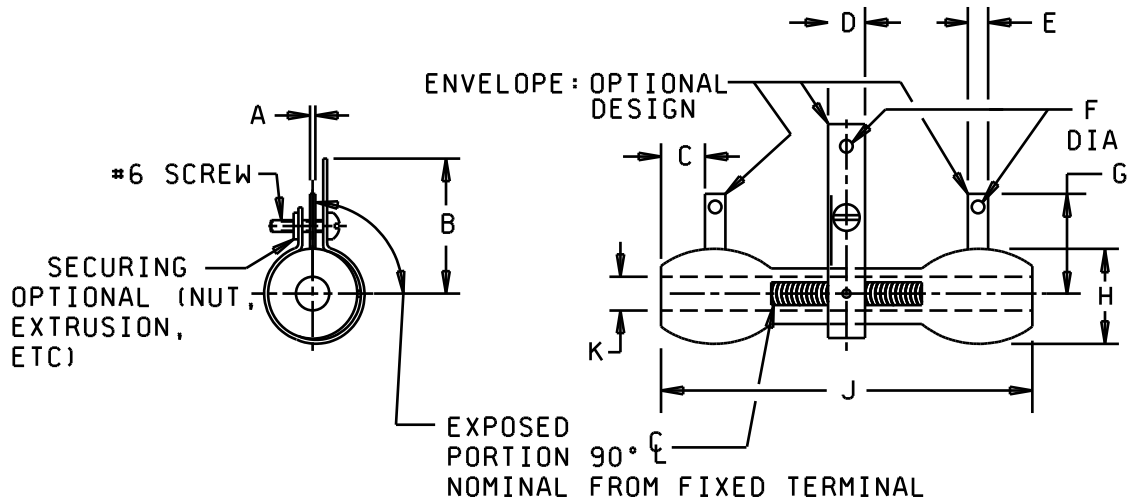
Characteristic	Power rating (watts)	Resistance range in ohms	
		Minimum	Maximum
V	26	1	1,500

NOTES:

1. All dimensions in inches.
2. For information on supplementary insulation and standard bracket assembly (mounting hardware, see 6.6 and 6.7.1).

FIGURE 4. Style RX33.

MIL-R-19365E
w/Amendment 1



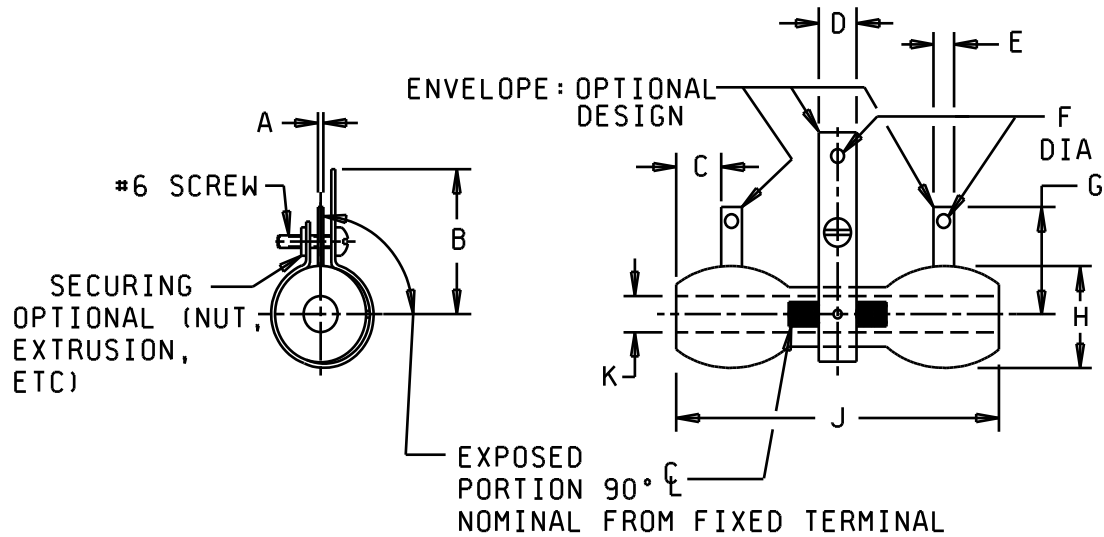
Letter	Inches (mm)		Letter	Inches (mm)	
	Min	Max		Min	Max
A	.016 (0.41)		F	.085 (2.16)	
B		1.320 (33.53)	G	.687 (17.45)	.937 (23.80)
C	.062 (1.57)		H		.906 (23.01)
D	.218 (5.54)	.281 (7.14)	J	3.938 (49.23)	4.062 (103.17)
E	.171 (4.34)	.328 (8.33)	K	.468 (11.89)	.552 (14.02)

Characteristic	Power rating (watts)	Resistance range in ohms	
		Minimum	Maximum
V	55	1	3,600

NOTES:

1. All dimensions in inches.
2. Dimension K - applies for at least .5 inch (12.7 mm) from end of the tube; the remainder of the hole shall in no case be less than .25 inch (6.35 mm).
3. For information on supplementary insulation and standard bracket assembly (mounting hardware, see 6.6 and 6.7.1).

FIGURE 5. Style RX35.



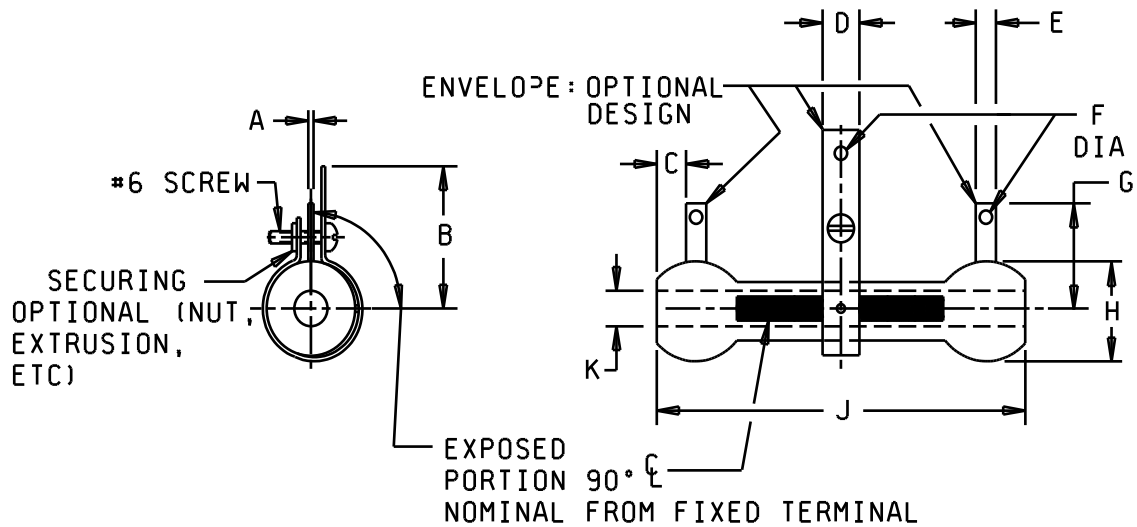
Letter	Inches (mm)		Letter	Inches (mm)	
	Min	Max		Min	Max
A	.016 (0.41)		F	.085 (2.16)	
B		1.531 (38.89)	G	1.093 (27.76)	1.343 (34.11)
C	.062 (1.57)		H		1.312 (33.32)
D	.218 (5.54)	.328 (8.33)	J	3.938 (49.23)	4.062 (103.17)
E	.171 (4.34)	.328 (8.33)	K	.704 (17.88)	.906 (23.01)

Characteristic	Power rating (watts)	Resistance range in ohms	
		Minimum	Maximum
V	78	1	5,100

NOTES:

1. All dimensions in inches.
2. Dimension K - applies for at least .5 inch (12.7 mm) from end of the tube; the remainder of the hole shall in no case be less than .25 inch (6.35 mm).
3. For information on supplementary insulation and standard bracket assembly (mounting hardware, see 6.6 and 6.7.1).

FIGURE 6. Style RX36.



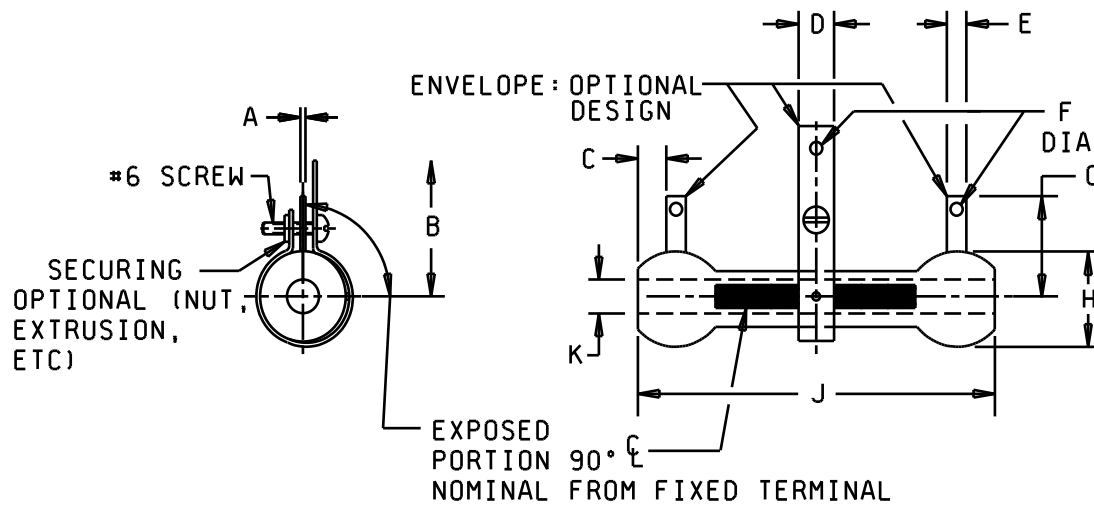
Letter	Inches (mm)		Letter	Inches (mm)	
	Min	Max		Min	Max
A	.016 (0.41)		F	.085 (2.16)	
B		1.531 (38.89)	G	1.093 (27.76)	1.343 (34.11)
C	.062 (1.57)		H		1.312 (33.32)
D	.218 (5.54)	.328 (8.33)	J	5.938 (150.38)	6.062 (153.97)
E	.171 (4.34)	.328 (8.33)	K	.704 (17.88)	.906 (23.01)

Characteristic	Power rating (watts)	Resistance range in ohms	
		Minimum	Maximum
V	113	1	8,200

NOTES:

1. All dimensions in inches.
2. Dimension K - applies for at least .5 inch (12.7 mm) from end of the tube; the remainder of the hole shall in no case be less than .25 inch (6.35 mm).
3. For information on supplementary insulation and standard bracket assembly (mounting hardware, see 6.6 and 6.7.1).

FIGURE 7. Style RX37.



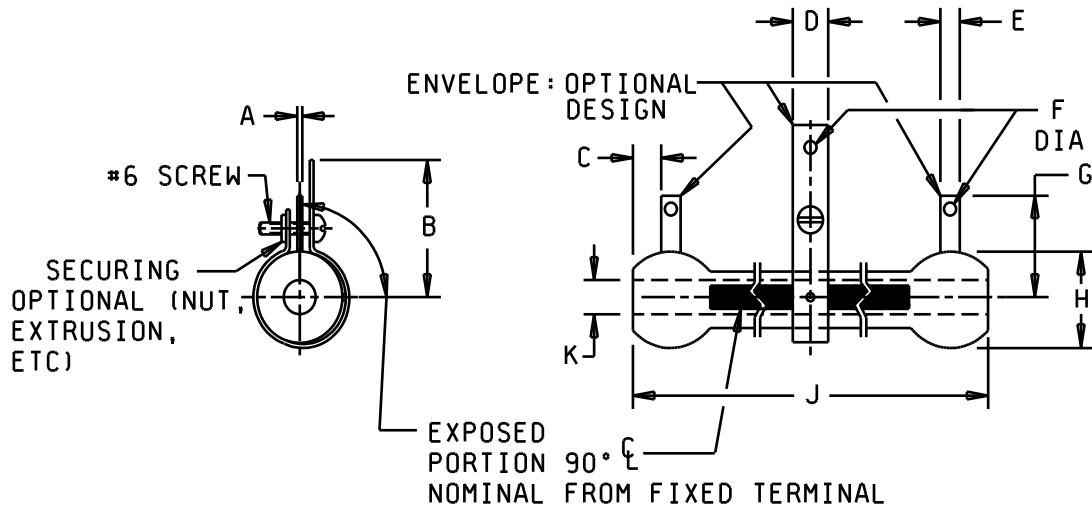
Letter	Inches (mm)		Letter	Inches (mm)	
	Min	Max		Min	Max
A	.016 (0.41)		F	.085 (2.16)	
B		1.531 (38.89)	G	1.093 (27.76)	1.343 (34.11)
C	.062 (1.57)		H		1.312 (33.32)
D	.218 (5.54)	.328 (8.33)	J	7.938 (201.63)	8.062 (204.77)
E	.171 (4.34)	.328 (8.33)	K	.704 (17.88)	.906 (23.01)

Characteristic	Power rating (watts)	Resistance range in ohms	
		Minimum	Maximum
V	159	1	11,000

NOTES:

1. All dimensions in inches.
2. Dimension K - applies for at least .5 inch (12.7 mm) from end of the tube; the remainder of the hole shall in no case be less than .25 inch (6.35 mm).
3. For information on supplementary insulation and standard bracket assembly (mounting hardware, see 6.6 and 6.7.1).

FIGURE 8. Style RX38.



Letter	Inches (mm)		Letter	Inches (mm)	
	Min	Max		Min	Max
A	.016 (0.41)		F	.085 (2.16)	
B		1.531 (38.89)	G	1.093 (27.76)	1.343 (34.11)
C	.062 (1.57)		H		1.312 (33.32)
D	.218 (5.54)	.328 (8.33)	J	9.938 (252.43)	10.062 (255.57)
E	.171 (4.34)	.328 (8.33)	K	.704 (17.88)	.906 (23.01)

Characteristic	Power rating (watts)	Resistance range in ohms	
		Minimum	Maximum
V	210	1	15,000

NOTES:

1. All dimensions in inches.
2. Dimension K - applies for at least .5 inch (12.7 mm) from end of the tube; the remainder of the hole shall in no case be less than .25 inch (6.35 mm).
3. For information on supplementary insulation and standard bracket assembly (mounting hardware, see 6.6 and 6.7.1).

FIGURE 9. Style RX47.

3.8 Resistance temperature characteristic. When resistors are tested as specified in 4.7.3, the resistance temperature characteristic shall not exceed ± 0.040 percent/ $^{\circ}\text{C}$. For resistors having a resistance value up to and including 0.25 ohm per square inch of winding area, and shall not exceed ± 0.026 percent/ $^{\circ}\text{C}$ for all other resistors.

3.9 Temperature. When resistors are tested as specified in 4.7.4, there shall be no evidence of mechanical damage. Softening of solder during the test, except where it is used solely as a tinning agent, shall be considered a basis for failure.

3.10 Dielectric withstanding voltage. When tested as specified in 4.7.5, resistors shall not flashover, show any evidence of mechanical damage, arcing, or insulation breakdown nor change in resistance in excess of 0.1 percent.

3.11 Insulation resistance. When resistors are tested as specified in 4.7.6, insulation resistance shall be not less than 100 megohms.

3.12 Power rating. When tested as specified in 4.7.7, resistors shall dissipate the rated power input exceeding the maximum applicable hot spot surface temperature (see table I). (The hot spot is the point or elemental area of maximum temperature on the external surface of a resistor.) There shall be no evidence of intermittent open circuiting in the winding (see 3.1), and the change in resistance as a result of this test shall not exceed 0.5 percent.

3.13 Thermal shock. When resistors are tested as specified in 4.7.8, the change in resistance shall not exceed 2 percent; and there shall be no evidence of mechanical damage; nor any observable change in resistor coating, enclosure, or other parts which will adversely affect the performance of the resistor.

3.14 Short time overload. When resistors are tested as specified in 4.7.9, the change in resistance shall not exceed 2 percent, and there shall be no evidence of mechanical damage, arcing, burning, or charring.

3.15 Moisture resistance. When resistors are tested as specified in 4.7.10, the change in total resistance and the resistance between the adjustable and fixed end terminals shall not exceed 5 percent. The insulation resistance shall not be less than 2.5 megohms. There shall be no evidence of mechanical damage, breaking, cracking, spalling, nor loosening of terminals or mounting hardware.

3.16 Mechanical strength. When resistors are tested as specified in 4.7.11, there shall be no evidence of mechanical damage.

3.17 Terminal strength. When resistors are tested as specified in 4.7.12, there shall be no evidence of mechanical damage, nor breaking or loosening of terminals.

3.18 Life. When tested as specified in 4.7.13, resistors shall dissipate not less than the rated power input, without exceeding a change in resistance of 5 percent between the initial measurement and any succeeding measurement. There shall be no evidence of mechanical damage.

3.19 Marking. Resistors shall be marked in accordance with [MIL-STD-1285](#). The type designation and the manufacturer's name or code symbol, or both, shall be marked on the body of the resistor, parallel to the longitudinal axis. There shall be no space between the symbols which comprise the type designation. If lack of space requires it, the type designation may appear on two lines. In this event, the type designation shall be divided between the style and the characteristic designations as shown in the following example:

RX29
V100

For resistors having a body of more than 2 inches nominal length, the resistance value in ohms preceded by the abbreviation for "resistance" and the power rating value in watts followed by the abbreviation for "nominal" shall also be marked as shown in the following example:

RX33V162
RES 1600
26 W NOM

(Manufacturer's name or code symbol, or both)

Marking shall remain legible at the end of all tests.

3.20 Soldering. Where soldering is employed, only noncorrosive fluxes shall be used unless it can be shown that corrosive elements have been satisfactorily removed after soldering. Solder shall not be used for obtaining mechanical strength. Electrical connections shall be mechanically secure before soldering and electrically continuous after soldering. Except for solder used to coat terminals, the solder used shall in no case start to melt at a temperature of less than 360°C.

3.21 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of resistor components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see [6.12](#)).

3.22 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.23 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality, and shall be free from holes, fissures, chip, corrosion, and malformation; the terminals shall be unbroken and not crushed or nicked; and the resistors shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see [4.4](#)).
- b. Conformance inspection (see [4.6](#)).

4.2 Test equipment and inspection facilities. The supplier shall establish and maintain a calibration system in accordance with [NCSL Z540.3](#), [ISO 10012](#), or equivalent system as approved by the qualifying activity.

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the [GENERAL REQUIREMENTS](#) of [MIL-STD-202](#).

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see [6.3](#)) on sample units produced with equipment and procedures normally used in production.

MIL-R-19365E
w/Amendment 1

4.4.1 Sample. The number of sample units comprising a sample of resistors to be submitted for qualification inspection shall be as specified in the [appendix A](#) to this specification.

4.4.2 Test routine. The coated or enclosed sample units will be subjected to the qualification inspection specified in table V, in the order shown. All coated or enclosed sample units will be subjected to the test and examinations of group I. These sample units will then be divided equally into two groups, for groups II and III, and subjected to the tests for their particular group. The uncoated or unenclosed sample units will be subjected to the examinations of group IV.

4.4.3 Failures. Failures in excess of those allowed in table V will be cause for refusal to grant qualification.

4.5 Retention of qualification. Every 12 months, the manufacturer shall verify the retention of qualification to the qualifying activity. In addition, the manufacturer shall immediately notify the qualifying activity whenever the group B inspection results indicate failure of the qualified product to meet the requirements of this specification. Verification shall be based on meeting the following requirements:

- a. The manufacturer has not modified the design of the item.
- b. The specification requirements for the item have not been amended so far as to affect the character of the item.
- c. Lot rejection for group A inspection does not exceed the group A sampling plan.
- d. The requirements for group A inspection are met.

When group B requirements were not met and the manufacturer has taken corrective action satisfactory to the Government, group B inspection retesting shall be instituted.

TABLE V. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph	Number of failure allows
<u>Group I</u>			
DC resistance	3.7	4.7.1	0
Visual and mechanical examination ^{1/}	3.1 , 3.3 to 3.5 incl., 3.19 to 3.23 incl.	4.7.2	
<u>Group II</u>			1
Resistance temperature characteristic	3.8	4.7.3	
Temperature	3.9	4.7.4	
Dielectric withstanding voltage	3.10	4.7.5	
Insulation resistance	3.11	4.7.6	
Power rating	3.12	4.7.7	
Thermal shock	3.13	4.7.8	
Short time overload	3.14	4.7.9	
Moisture resistance	3.15	4.7.10	
Mechanical strength	3.16	4.7.11	
Terminal strength	3.17	4.7.12	
<u>Group III</u>			
Life	3.18	4.7.13	
<u>Group IV</u>			
Visual and mechanical examination	3.1 , 3.3 to 3.5 incl., 3.19 to 3.23 incl.	4.7.2	0

^{1/} Marking will be considered defective only if the marking is illegible.

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A and B inspection.

4.6.1.1 Inspection lot. An inspection lot, as far as practical, shall include resistors of any style within a given group shown in [table V](#) without regard to resistance value or resistance tolerance, produced under essentially uniform conditions and offered for inspection at one time. Resistors that differ in design, construction, materials, and terminal type shall not be included in one lot.

4.6.2 Group A inspection. Group A inspection shall consist of the examinations and test specified in table VI, and shall be made on the same set of sample units, in the order shown.

TABLE VI. Group A inspection.

Test	Requirement paragraph	Method Paragraph	Number of samples
DC resistance	3.7	4.7.1	See 4.6.2.1
Visual and mechanical examination		4.7.2	
Overall body dimensions	3.4		
Other physical dimensions	3.4		
Terminals	3.4.3, 3.4.3.1		
Marking	3.19		
Workmanship	3.23		

4.6.2.1 Sampling plan. A sample of parts from each inspection lot shall be randomly selected in accordance with table VII, if one or more defects are found, the lot shall be rescreened and defects removed. After screening and removal of defects, a new sample of parts shall be randomly selected in accordance with table VII, if one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification. Resistance values shall be representative, and where possible, in proportion to the resistors in the inspection lot.

TABLE VII. Group A sampling plan.

Lot size			Sample size
1	to	13	100 percent
14	to	150	13
151	to	280	20
281	to	500	29
501	to	1,200	34
1,201	to	3,200	42
3,201	to	10,000	50
10,001	to	35,000	60
35,001	to	150,000	74
150,001	to	500,000	90
500,001	and over		102

MIL-R-19365E
w/Amendment 1

4.6.3 Group B inspection. Group B inspection shall consist of the tests specified in table VIII, in the order shown. They shall be performed on sample units that have been subjected to and have passed the group A inspection, unless the Government considered it more practical to select a separate sample from the lot for group B inspection.

TABLE VIII. Group B inspection. 1/

Test	Requirement paragraph	Method paragraph	Number of samples
Temperature	3.9	4.7.4	See 4.6.3.1
Dielectric withstanding voltage	3.10	4.7.5	
Insulation resistance	3.11	4.7.6	
Thermal shock	3.13	4.7.8	
Short time overload	3.14	4.7.9	

1/ If the manufacturer can demonstrate that this test has been performed 5 consecutive times with zero failures, the frequency of this test, with approval of the qualifying activity, can be performed on an annual basis. If the design, material, construction or processing of the part is changed, or if there are quality problems or failures, the qualifying activity may require resumption of the original test.

4.6.3.1 Sampling plan. A sample of parts shall be randomly selected in accordance with table IX, if one or more defects are found, the lot shall be rescreened and defects removed. After screening and removal of defects, a new sample of parts shall be randomly selected in accordance with table IX, if one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.3.2 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract or order. When an inspection lot is rejected on group B inspection, the supplier shall immediately investigate the cause of failure and take corrective action to assure that subsequent lots do not contain the same defect or defects.

TABLE IX. Group B sampling plan.

Lot size	Sample size
2 to 5	100 percent
6 to 50	5
51 to 90	7
91 to 150	11
151 to 280	13
281 to 500	16
501 to 1,200	19
1,201 to 3,200	23
3,201 to 10,000	29
10,001 to 35,000	35
35,001 and over	40

4.6.4 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation and packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

4.7 Methods of inspection.

4.7.1 DC resistance (see 3.7). The dc resistance shall be measured in accordance with [method 303](#) of [MIL-STD-202](#) and as specified in 4.7.1.1 and 4.7.1.2. The following details and exceptions shall apply:

- a. Measuring apparatus: Different types of measuring test equipment (multimeters, bridges, or equivalent) are permitted to be used on the initial and final readings of this test, provided the equipment is the same style, model, or it can be shown that the performance of the equipment is equivalent or better.
- b. Test voltage: Measurements of resistance shall be made by using a dc potential resulting in not more than 1 percent of rated wattage (see 3.6). The voltage used for the initial measurement shall be used for all subsequent measurements.

4.7.1.1 Total (see 3.7.1). The dc resistance shall be measured as specified in 4.7.1 between the two fixed end terminals. For the initial tolerance determination, the total resistance shall be measured with the adjustable terminal removed from the resistor.

4.7.1.2 Maximum engageable (see 3.7.2). The dc resistance shall be measured as specified in 4.7.1, between each fixed end terminal and the adjustable terminal, with the latter positioned farthest from the fixed end terminal, while still engaging the bare resistance wire.

4.7.2 Visual and mechanical examination. Resistors shall be examined to verify that the materials, design, construction, physical dimensions, marking and workmanship are accordance with the applicable requirements (see 3.1, 3.3 to 3.5 incl., and 3.19 to 3.23 incl.).

4.7.3 Resistance temperature characteristic (3.8).

4.7.3.1 Qualification inspection. Resistors shall be tested in accordance with [method 304](#) of [MIL-STD-202](#). The following detail and exception shall apply:

- a. Test temperatures: As specified in table X.
- b. Measurement at end of each period: Total resistance shall be measured as specified in 4.7.1.1, at the temperature maintained during the period.

TABLE X. Resistance temperature characteristic test ambient temperatures.

Sequence	Test ambient temperature (°C)
1	25 ^{1/}
2	-55
3	25 ^{1/}
4	125
5	200
6	275
7	350

^{1/} This temperature shall be considered the reference for each succeeding temperatures.

4.7.3.2 Product acceptance inspection. Resistors shall be tested as specified in 4.7.3.1, except that sequences 1, 2, 3, and 7 of table X shall be performed only, in that order.

4.7.4 Temperature (see 3.9). Resistors shall be placed in an oven at room temperature. The temperature of the oven shall then be elevated gradually to the maximum hotspot surface temperature of the resistor $+5^{\circ}\text{C}$, -0°C (see table I). The period of the transition from room temperature to the hotspot surface temperature shall be accomplished in not more than 45 minutes. For conformance inspection, at the option of the manufacturer, the resistors may be placed in an oven whose temperature has already been brought up to approximately the hotspot surface temperature. The resistors shall be conditioned at the latter temperature for a two hours. They shall then be allowed to cool gradually to room temperature, after which they shall be visually examined for evidence of mechanical damage.

4.7.5 Dielectric withstanding voltage (see 3.10). Resistors shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

- a. Special preparations: Resistors shall be mounted, without supplementary insulation, between two metal plates normal to the longitudinal axis of the resistor, one plate at each end, held firmly against the end of the resistor core by a through bolt. These plates shall be of sufficient size to extend beyond the resistor terminal extremities. The adjustable terminal shall be positioned within ± 5 percent of the electrical center.
- b. Magnitude of test voltage: 1,000 volts.
- c. Nature of potential: Alternating current (ac) supply at commercial line frequency and waveform.
- d. Points of application of test voltage: Between the terminals tied together, and the mounting hardware and plates.
- e. Examination and measurements: Total resistance shall be measured before and after the test. At the conclusion of the test, resistors shall be examined for evidence of mechanical damage, arcing, and insulation breakdown.

4.7.6 Insulation resistance (see 3.11). Resistors shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

- a. Test condition letter: - A.
- b. Special preparations: As specified in 4.7.5a.
- c. Points of measurement: As specified in 4.7.5d with the positive lead connected to the winding and the negative lead to the mounting hardware.

4.7.7 Power rating (see 3.12). The adjustable terminal shall be positioned at one end as close to the fixed end terminal as possible while still engaging the bare resistance wire. The resistors shall be mounted horizontally with the exposed portion facing downward. Total resistance shall be mounted as specified in 4.7.1.1. The resistors shall be supported without mounting hardware by means of their terminals in free space and still air (see note for table IV) at an ambient temperature of 25°C $+5^{\circ}\text{C}$, -0°C (see 4.7.7.1). If the power rating is measured at any ambient temperature other than 25°C , a power rating correction factor with reference to 25°C $+5^{\circ}\text{C}$, -0°C ambient temperature shall be applied in accordance with the derating curve shown on figure 1. Rated wattage from an ac supply at commercial line frequency and waveform shall be applied to the fixed end terminals until thermal stability has been reached. During the test, added precaution shall be taken to determine the possibility of intermittent open circuiting in the winding. The hotspot surface temperature shall be determined by the use of a thermocouple. (see 4.7.7.2). Measurements of resistance shall be made not less than 2 hours after removal of the load potential.

4.7.7.1 Measurement of ambient temperature. The ambient temperature shall be measured on a level with, and at a point 12 inches from, the nearest resistor under test.

4.7.7.2 Thermocouple. The thermocouple junction shall rest on the hotspot, and the thermocouple wires shall hang down on opposite sides of the resistor. Precaution shall be taken that the thermocouple wire does not touch the exposed portion of the resistor. Weights of at least 2 ounces on each wire lead shall provide the pressure of the thermocouple junction against the surface of the resistor under test. The thermocouple shall be composed of wire .010 inch (0.25 mm) in diameter (AWG size 30), or smaller. The thermocouple wire shall not extend more than .125 inch (3.18 mm) beyond the junction. A negligible difference of potential may exist between the thermocouple and the resistor winding so as to prevent a possible dielectric failure of the coating.

4.7.8 Thermal shock (see 3.13). Resistors shall be mounted on a rack of low heat conducting material. Following a measurement of total resistance (see 4.7.1.1), rated wattage from an ac supply at commercial line frequency and waveform shall be applied until thermal stability has been reached. The power shall then be removed and, within 8 second to 12 second, the resistors shall be subjected to an air temperature of $-55^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for a period of not less than 15 minutes nor more than 30 minutes. Total resistance shall again be measured not less than 2 hours after final exposure. Resistors shall then be examined for evidence of mechanical damage and change in any part of the resistors.

4.7.9 Short time overload (see 3.14). Resistors shall be mounted by their normal mounting means. Following a measurement of total resistance (see 4.7.1.1), a potential from an ac supply at commercial line frequency and waveform which will result in 10 times the rated wattage (see 3.1) shall be applied to the resistors for 5 seconds. In no case shall this voltage exceed 6,000 volts. Total resistance shall again be measured after the resistors have cooled to room temperature. Resistors shall then be examined for evidence of mechanical damage, arcing, burning, and charring.

4.7.10 Moisture resistance (see 3.15). Resistors shall be tested in accordance with [method 106](#) of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting: All resistors shall have their adjustable terminal positioned within ± 5 percent of electrical center. Resistors under load shall be mounted horizontally not less than 2.5 inches apart and with their terminals pointing upward, as follows:
 - (1) One half of the resistors shall be mounted by means of their associated hardware (see 3.1), with supplementary insulation.
 - (2) The remaining half of the resistors shall be mounted, without supplementary insulation, between two metal plates normal to the longitudinal axis of the resistor (one plate at each end) held firmly against the ends of the resistor by through bolts. These plates shall be of sufficient size to extend beyond the extremities of the resistor terminals.
- b. Initial measurements: Resistance between adjustable terminal and fixed end terminals, total resistance, and insulation resistance shall be measured as specified in 4.7.1, 4.7.1.1, and 4.7.6, respectively.
- c. Load and polarization: One half of the resistors shall be subjected to load (see 4.7.10a.1) and the remaining half to polarization (see 4.7.10a.2).
 - (1) Load: During the first 2 hours of each of steps 1 and 4, one half the rated wattage from a dc supply, derated in accordance with the derating curve shown on [figure 1](#) to the temperature attained at the end of the 2 hour period, shall be applied to each half of the resistor with the positive lead connected to the adjustable terminal, and a negative lead to each of the fixed end terminals. The negative terminals shall be electrically grounded to the mounting surface.
 - (2) Polarization: During steps 2 and 3, and 5 and 6 a potential of 100 volts dc shall be applied with the positive lead connected to the terminals tied together, and the negative lead connected to the mounting hardware.

- d. Final measurements: At the end of the final cycle and while the resistors are still in the humidity chamber at the high humidity condition, the resistance between the adjustable terminal and fixed end terminals, total resistance, and insulation resistance shall be measured as specified in 4.7.1, 4.7.1.1, and 4.7.6, respectively. Resistors shall then be examined for evidence of mechanical damage, breaking, cracking, spalling, loosening of terminals or mounting hardware. (The subsequent 4 hours to 24 hours conditioning period and measurements do not apply).

4.7.11 Mechanical strength (see 3.16). Resistors shall be supported .125 inch (3.18 mm) from each end and subjected to a transverse load of 50 pounds applied at the center of the resistor through a fulcrum having a radius of not less than .250 inch (6.35 mm) nor more than .375 inch (9.53 mm). The load shall not be applied on the exposed portion of the resistor. Resistors shall then be examined for evidence of mechanical damage.

4.7.12 Terminal strength (see 3.17). Resistors shall be firmly clamped and a direct pull of 10 pounds shall be applied to the hole of each fixed end terminal for at least 30 seconds, one terminal at a time, in the direction away from the resistor and parallel to the longitudinal axis. Resistors shall then be examined for evidence of mechanical damage, and breaking or loosening of terminals.

4.7.13 Life (see 3.18).

4.7.13.1 Test conditions. This test shall be conducted at an ambient temperature of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Resistors shall be mounted by means of their associated hardware, and wire leads shall be soldered to their terminals to make connection for arranged that the temperature of any one resistor will not appreciably influence the temperature of any other resistor. There shall be no circulation of air over the resistors other than that caused by the heat of the resistors. The voltage used shall be the rated continuous working voltage from an ac waveform (see 3.6), and adequate precaution shall be taken to maintain constant voltage on resistors under test.

4.7.13.2 Procedure. Following a measurement of maximum engageable resistance (see 4.7.1.2), the voltage shall be applied intermittently, 1.5 hours "on" and 0.5 hour "off", for a total of 1,000 hours ± 12 hours. This voltage shall be applied to the terminals specified in 4.7.1.2. Resistance measurements (see 4.7.1.2) shall be made at the end of the 0.5 hour "off" periods after 50 hours ± 4 hours, 100 hours ± 8 hours, 250 hours ± 12 hours, 500 hours ± 12 hours, 750 hours ± 12 hours, and 1,000 hours ± 12 hours have elapsed. Resistors shall then be examined for evidence of mechanical damage.

5. PACKAGING.

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service or Defense Agency, or within the military services system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The resistors covered by this specification are military unique due to the fact that these devices must be able to operate satisfactorily in military systems under the following demanding conditions: 20 G's of high frequency vibration, 100 G's of shock (specified pulse), thermal shock (with no more than 1 percent deviation in initial resistance), and a low temperature coefficient of resistance. In addition, these military requirements are verified under a qualification system. Commercial components are not designed to withstand these military environmental conditions.

6.2 Ordering data. Acquisition documents must specify the following:

- a. Title, number, and date of this specification, and the complete PIN (see 1.2).
- b. If not otherwise specified (see 2.1), the versions of the individual documents referenced will be those in effect on the date of release of the solicitation.
- c. Packaging instructions (see 5.1).
- d. Bracket assembly requirements (see 6.7.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in [Qualified Product List 19365](#) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the QPL and, information pertaining to qualification of products may be obtained from the DLA Land and Maritime, ATTN: VQP, Post Office Box 3990, Columbus, OH 43218-3990. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil> or <http://www.landandmaritime.dla.mil/Programs/QmlQpl/>.

6.4 Power dissipation. Resistors are rated in accordance with 4.7.7. When higher ambient temperatures exist or when resistors are mounted in enclosures which limit ventilation, the wattage dissipation of any resistor should be reduced in accordance with [figure 1](#), so that the maximum continuous operating temperature permissible for the resistor is never exceeded under the most severe combination of temperature conditions (see 6.8).

6.5 Spacing. When resistors are mounted in rows or banks, they should be so spaced that, taking into consideration the restricted ventilation and heat dissipation of the nearby resistors, none of the maximum permissible continuous operating temperature. An appropriate combination of resistor spacing and resistor power rating must be chosen if this is to be assured.

6.6 Supplementary insulation. When voltages greater than 500 volts dc, or 350 volts ac rms, are present between resistor circuits and grounded surfaces on which resistors are mounted, supplementary insulation capable of withstanding the voltage condition should be provided between resistors and mountings and ground.

6.7 Mounting. Resistor should not be mounted by their terminals.

6.7.1 Bracket assemblies. When required (see 6.2), bracket assemblies (mounting hardware) are available for these resistors under [MS75009](#), Bracket Assembly, Resistor (Power Type).

6.8 Choice of styles. The styles of resistors to be used in equipment should be so chosen that, when mounted in the equipment, they will not be required to operate at a temperature in excess of their rating. This should be applicable under the most severe combination of conditions with the equipment operating as follows:

- a. In the maximum specified ambient temperature.
- b. Under conditions producing maximum temperature rise in each resistor.
- c. For a sufficient length of time to produce maximum temperature rise, or for the maximum specified time.
- d. With all enclosures in place.
- e. With natural ventilation only (this should permit the use of any special ventilating provisions included as a standard part of the equipment).
- f. At high altitude.

6.9 Soldering. When operated at full load, the maximum temperature may be 350°C. The solder used for connecting leads to the terminals should be chosen accordingly.

6.10 High frequency. Resistors should not be used in circuits where their ac performance is of critical importance in the operation of such circuits.

6.11 Adjustments. Lugs should always be loosened completely before moving and should not be except while the voltage is off, in order to protect the operator from dangerous voltages. When adjusted to the position desired, the adjustable terminal should be tightened sufficiently to assure good electrical contact.

6.12 Tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to [ASTM-B545](#) (Standard Specification for Electrodeposited Coatings of Tin).

6.13 Subject term (key word) listing.

Bracket assemblies
High frequency
Hotspot surface temperature

6.14 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmental Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website <http://www.epa.gov/osw/hazard/wastemin/priority.htm>. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

6.15 Amendment notification. The margins of this specification are marked with vertical lines to indicate modification generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship.

APPENDIX A

PROCEDURE FOR QUALIFICATION INSPECTION

A.1. SCOPE

A.1.1 Scope. This appendix details the procedure for submission of sample, with test results, for qualification inspection of resistors covered by this specification. The procedure for extending qualification required sample to other resistors covered by this specification is also outlined herein. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

A.3. SUBMISSION

A.3.1 Sample. A sample consisting of 12 coated or enclosed sample units, of the styles specified in column 1 of table A-I of the highest resistance value and using a nominal diameter wire of .004 inch (0.10 mm), shall be submitted for each style for which qualification is sought. If the same coating and material are not used, a separate submission shall be furnished for each coating and material for which qualification is sought. Four uncoated or unenclosed sample units shall also be submitted in each style specified in column 1 of table A-I. If enclosures are used in lieu of coatings, four enclosures shall also be furnished. Sample units shall be submitted complete with supplementary insulation and mounting hardware normally used for mounting the resistors. The submitted samples shall be representative of the supplier's normal production.

TABLE A-I. Style qualification.

Style	Styles qualified
RX29	RX29
RX32	RX29, RX32
RX33	RX29, RX32, RX33
RX35	RX29, RX32, RX33, RX35
RX36	RX36
RX37	RX36, RX37
RX38	RX36, RX37, RX38
RX47	RX36, RX37, RX38, RX47

A.4. EXTENT OF QUALIFICATION

A.4.1 Extent of qualification. Qualification of a particular style and resistance value will qualify a range of resistance values from the smallest value listed in the style (see A.3.1) to the resistance value tested. In addition, qualification of one style will be the basis for qualification of another style (or styles), as specified in table A-I.

MIL-R-19365E
w/Amendment 1

Custodians:

Army - CR
Navy - EC
Air Force - 85
DLA - CC

Preparing activity:
DLA - CC

(Project 5905-2014-007)

Review activities:

Army - AR, AT, AV, CR4, MI
Navy - AS, CG, MC, OS
Air Force - 19

NOTE: The activities listed above were interested in this document as of the date of the this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the Assist Online database at <https://assist.dla.mil>.